

IN THE CLAIMS:

Please cancel claims 2, 4, 5, 10, 12 and 13 in their entirety without prejudice nor disclaimer of the subject matter set forth therein.

1. (Canceled)

2. (Canceled)

3. (Previously Presented) A junction method for joining a workpiece made of a plurality of plate materials superimposed in their thickness directions at points, said method utilizing a junction tool which is configured by first and second tools placed on a junction axis substantially perpendicular to superimposed surfaces of the workpiece while nipping the workpiece therebetween and which has a pin protruding from a distal end surface of the first tool along the junction axis, a recess depressed at a distal end surface of the second tool along the junction axis, and an annular convex portion formed at the distal end surface of the second tool so as to surround the recess,

said method comprising:

a first step of nipping the workpiece with the junction tool in the direction of the junction axis and pressing the same while rotating one or both of the first and second tools about the junction axis so as to sink the pin of the first tool and the convex portion of the second tool into the workpiece;

a second step of caulking, in the direction of the junction axis, the superimposed surfaces of the workpiece softened by a friction heat generated by a rotation of the junction tool between the pin of the first tool and the recess of the second tool;

a third step of generating plastic flow within the workpiece by the rotation of the junction tool thereby agitating the vicinity of the superimposed surfaces of the workpiece;
and

a fourth step of pulling the junction tool from the workpiece.

4. (Canceled)

5. (Canceled)

6. (Previously Presented) A junction method for joining a workpiece made of a plurality of plate materials superimposed in their thickness directions at points, said method utilizing a junction tool which is configured by first and second tools placed on a junction axis substantially perpendicular to superimposed surfaces of the workpiece while nipping the workpiece therebetween and which has a pin protruding from a distal end surface of the first tool along the junction axis, an annular concave groove formed at the distal end surface so as to surround the pin, a recess depressed at a distal end surface of the second tool along the junction axis and an annular convex portion formed at the distal end surface of the second tool so as to surround the recess,

said method comprising:

a first step of nipping the workpiece with the junction tool in the direction of the junction axis and pressing the same while rotating one or both of the first and second tools about the junction axis so as to sink the pin of the first tool and the convex portion of the second tool into the workpiece;

a second step of caulking, in the direction of the junction axis, the superimposed surfaces of the workpiece softened by a friction heat generated by rotation of the junction tool between the pin and the concave groove of the first tool and the recess and the convex portion of the second tool;

a third step of generating plastic flow within the workpiece by the rotation of the junction tool thereby agitating the vicinity of the superimposed surfaces of the workpiece;
and

a fourth step of pulling the junction tool from the workpiece.

7. (Previously Presented) The junction method of Claim 6, wherein the distal end surface of one of the first and second tools of the junction tool has a larger diameter than that of the other of the first and second tools, and

in the first to fourth steps, among the first and second tools, one that has a distal end surface with the larger diameter is rotated about the junction axis.

8. (Previously Presented) The junction method of Claim 6, wherein one of the first and second tools of the junction tool has a large diameter portion which has a larger diameter than that of the distal end surface of the other tool and a small diameter portion which is placed at the distal end side of the tool with respect to the large diameter portion and is smaller in the diameter than the large diameter portion, and

in the first to fourth steps, among the first and second tools, the tool with the large and small diameter portions is rotated about the junction axis.

9. (Canceled)

10. (Canceled)

11. (Previously Presented) A junction device, comprising: a junction tool for joining a workpiece made of a plurality of plate materials superimposed in their thickness directions at points, comprising:

first and second tools that are placed on a junction axis substantially perpendicular to superimposed surfaces of the workpiece so as to nip the workpiece, and one or both of the first and second tools being disposed so as to be rotated about the junction axis, and

a junction tool driving means,

wherein the first tool is provided with a pin protruding from its distal end surface along the junction axis,

the second tool is provided with a recess which is depressed at its distal end

surface along the junction axis and an annular convex portion which surrounds the recess,
and

the junction tool driving means being configured for nipping the workpiece with the junction tool in the direction of the junction axis and pressing the same while rotating at least one the first and second tools about the junction axis so as to sink the pin of the first tool and the convex portion of the second tool into the workpiece;

caulking, in the direction of the junction axis, the superimposed surfaces of the workpiece softened by friction heat generated between the pin of the first tool and the recess of the second tool by rotation of the junction tool;

generating plastic flow within the workpiece by the rotation of the junction tool thereby agitating the vicinity of the superimposed surfaces of the workpiece; and

pulling the junction tool from the workpiece.

12. (Canceled)

13. (Canceled)

14. (Previously Presented) A junction device, comprising; a junction tool for joining a workpiece made of a plurality of plate materials superimposed in their thickness directions at points, the junction tool comprising:

first and second tools that are placed on a junction axis substantially perpendicular to superimposed surfaces of the workpiece so as to nip the workpiece, and one or both of the first and second tools being disposed so as to be rotated about the junction axis,
and

a junction tool driving means,

wherein the first tool is provided with a pin protruding from its distal end surface along the junction axis and an annular concave groove at the distal end surface so as to surround the pin,

the second tool is provided with a recess which is depressed at its distal end surface along the junction axis and an annular convex portion at the distal end surface so as to surround the recess and

the junction tool driving means being configured for:

nipping the workpiece with the junction tool in the direction of the junction axis and pressing the same while rotating at least one of the first and second tools about the junction axis so as to sink the pin of the first tool and the convex portion of the second tool into the workpiece:

caulking, in the direction of the junction axis, the superimposed surfaces of the workpiece softened by friction heat generated between the pin and the concave groove of the first tool and the recess and the convex portion of the second tool by the rotation of the junction tool;

generating plastic flow within the workpiece by the rotation of the junction tool thereby agitating the vicinity of the superimposed surfaces of the workpiece; and

pulling the junction tool from the workpiece.

15. (Previously Presented) The junction device of Claim 14, wherein the distal end surface of one of the first and second tools has a larger diameter than that of the other of the first and second tools.

16. (Previously Presented) The junction device of Claim 14, wherein one of the first and second tools has a large diameter portion which has a larger diameter than that of the distal end surface of the other tool and a small diameter portion which is placed at the distal end side of the tool with respect to the large diameter portion and is smaller in diameter than the large diameter portion.

17. (Previously Presented) The junction method of Claim 3, wherein the distal end surface of one of the first and second tools of the junction tool has a larger diameter

than that of the other of the first and second tools, and

in the first to fourth steps, among the first and second tools, one that has a distal end surface with the larger diameter is rotated about the junction axis.

18. (Previously Presented) The junction method of Claim 3, wherein one of the first and second tools of the junction tool has a large diameter portion which has a larger diameter than that of the distal end surface of the other tool and a small diameter portion which is placed at the distal end side of the tool with respect to the large diameter portion and is smaller in the diameter than the large diameter portion, and

in the first to fourth steps, among the first and second tools, the tool with the large and small diameter portions is rotated about the junction axis.

19. (Previously Presented) The junction device of Claim 11, wherein the distal end surface of one of the first and second tools has a larger diameter than that of the other of the first and second tools.

20. (Previously Presented) The junction device of Claim 11, wherein one of the first and second tools has a large diameter portion which has a larger diameter than that of the distal end surface of the other tool and a small diameter portion which is placed at the distal end side of the tool with respect to the large diameter portion and is smaller in the diameter than the large diameter portion.